

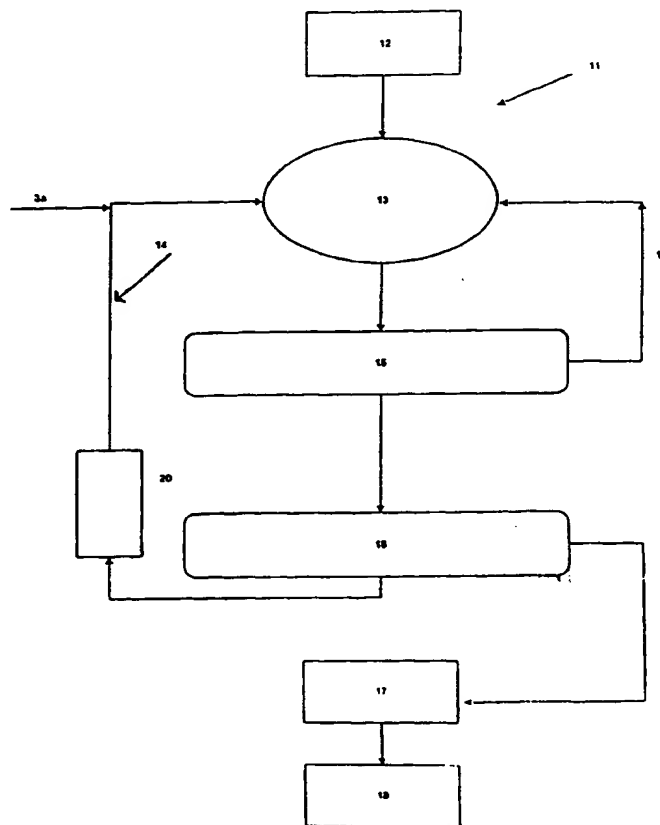


## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<b>(21) International Application Number:</b> PCT/NZ99/00031  <b>(22) International Filing Date:</b> 16 March 1999 (16.03.99)  <b>(30) Priority Data:</b> 329960                      16 March 1998 (16.03.98)                      NZ  <b>(71) Applicant (for all designated States except US):</b> ENVIRONMENT PRODUCTS LIMITED [NZ/NZ]; 667 Great South Road, Penrose, Auckland 1006 (NZ).  <b>(72) Inventor; and</b> <b>(75) Inventor/Applicant (for US only):</b> MOFFAT, David, John [AU/AU]; 8 Mascoma Street, Ascot Vale, VIC 3032 (AU).  <b>(74) Agents:</b> SIMS, Anthony, W. et al.; 29 Clarence Street, P.O. Box 759, Hamilton 2001 (NZ).		<b>(81) Designated States:</b> AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).  <b>Published</b> <i>Without international search report and to be republished upon receipt of that report.</i>

**(54) Title:** IMPROVED METHOD AND APPARATUS FOR PROCESSING A PREPARATION**(57) Abstract**

The present invention relates to a method of processing a wort stream used in the production of a beer, using at least one reverse osmosis membrane or nano filtration membrane as a filter stage, and at least one treatment stage wherein the method is characterised by the steps of: a) transferring the wort stream into contact with the filter stage, and b) passing water from the wort out of the filter stage as a permeate and retaining required components of the wort in contact with the filter stage as a retentate, and c) transferring the retained components of the wort stream to a treatment stage once carbohydrates in the wort have reached a set concentration level. A method for screening the wort to remove waste products using a screening stage before the wort reaches the filtering stage is also disclosed. The present invention provides a method and apparatus for removing the traditional requirement of the kettle and a whirlpool in the production of wort to be fermented into beer.



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# IMPROVED METHOD AND APPARATUS FOR PROCESSING A PREPARATION

## TECHNICAL FIELD

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This invention relates to an improved method and apparatus for processing a preparation.

Specifically the preparation referred to throughout the specification is a  
10 preparation used in the production of a beverage. However, it should be appreciated by those skilled in the art that other types of preparation may be processed in conjunction with the present invention, and reference to the above should in no way be seen as limiting.

## 15 BACKGROUND ART

Reference throughout the specification shall now be made to the preparation and its production as relating to preparations used in the production of beer.

20 The preparation referred to throughout is commonly known in the art of beer production as wort. However, it should be appreciated by those skilled in the art that other preparations may be processed in conjunction with the present invention. For example, in other embodiments, preparations used in the production of wine, cider or other low alcohol beverages may be processed in  
25 accordance with the present invention.

Current methods of preparing a stream of wort use a number of different stages and elements.

Most commonly a stream of wort is initially formed in a mash tun. A mash tun is a container that allows the content of the tun to be held at a given temperature and agitated. Malted grain is pre-weighed, milled and transferred into the mash tun with water heated to approximately 65°C. The mixture is then agitated and kept at  
5 65°C to promote enzymatic activity. The enzymatic activity cuts long chain carbohydrates into smaller, more easily fermented carbohydrates. After a set period of time the enzymatic activity is halted by raising the temperature of the wort mixture to approximately 74°C.

10 The wort is then transferred to a lauter tun. A lauter tun consists of a chamber with perforated bottom plates and a wort recirculation system, where the wort may be drawn through the perforated plates, through the recirculated system and then deposited back into the lauter tun. Husks from the malt will fall to the bottom of the tun and act as a crude filter, preventing large particles in the wort stream from  
15 being transferred to the next brewing vessel. Circulation of the wort in the lauter tun continues until the wort is clear of large particles. Throughout the sparging stage the perforated plates of the lauter tun trap and separate spent grain and other large particles from the wort to form a substantially clear wort stream. When the circulated wort has an acceptable clarity the flow is diverted to the kettle.

20

When the wort is just above the grain bed in the lauter tun, sparging commences. Sparging occurs when the brewer adds extra water at approximately 75°C to the wort in the lauter tun. The sparge water is sprayed into the lauter tun with the diluted wort passing through the grain bed to remove as much carbohydrate as  
25 possible from the remaining solid material in the wort.

The lauter tun is sparged while transferring wort to a kettle. The kettle contents will be boiled for approximately 60 minutes. The wort will be boiled in the kettle

to sterilise the solution, to stop any further enzymic activity, to precipitate proteins out of the solution, and to also set the correct concentration level of carbohydrates within the wort. After the wort is boiled continually for 60 minutes, the brewer may need to add water so as to achieve a set predetermined level of carbohydrate prior to transferring the wort to a whirlpool.

A whirlpool is shaped as a substantially circular container with a raised ring near the centre of the container. The wort stream is transferred into the whirlpool at a tangent to the side of whirlpool, spinning the fluid around within the container.

10 This spinning motion forces solid precipitated proteins into the centre of the whirlpool and down into the retaining ring. Once all the solid protein precipitate has moved into the retaining ring the wort is drained from the pool, leaving the solid protein in the whirlpool. In some cases hops may be added to the kettle for flavour, and residual hop material will also be forced into the whirlpool-retaining

15 ring.

From the whirlpool the wort is next transferred to a heat exchanger which cools it down to approximately 12°C. Next the wort stream is oxygenated using pure oxygen or sterile air and then transferred to a fermentation stage, in which the

20 wort is pitched with yeast and left to ferment into beer.

The wort preparation method discussed above involves a number of limitations and problems.

25 Firstly, when the wort is sparged in the lauter tun care must be taken to ensure that the carbohydrate level of the wort does not fall too low. If the extra water dilutes the wort past a certain carbohydrate concentration chemicals called beta-glucans may be leached from the grain bed, which creates a hazy beer due to filtration

difficulties. These compounds may also inhibit the metabolism of yeast during fermentation.

5 Further, as the wort is processed through the whirlpool at approximately 75°C the wort experiences continued oxidation that may lead to the formation of DMS (dimethyl sulphide) compounds within the wort. DMS formation should be avoided as it gives the beer a "cooked cabbage" flavour.

10 Oxidation of the wort in the kettle and whirlpool degrade chemical structure and organoleptic properties of the worts flavour compounds. If the wort is left in the kettle or whirlpool too long, the resulting beer will exhibit an undesirable oxidised flavour.

15 The process of boiling also promotes the loss of natural compounds that assist in the formation of a head on the beer. Normally, additional head promoting compounds must be added to wort processed with a kettle and whirlpool due to loss of these volatile components.

20 The wort preparation method discussed above also creates a large amount of high BOD (Biochemical Oxygen Demand) wastewater from the lauter tun. In some countries the BOD of materials discharged from particular industries is monitored and a business may be fined or penalised if it has discharged too much high BOD waste.

25 This is of concern in large scale brewing applications where a great deal of wastewater will be generated and needs to be disposed of carefully. As sparging must be cut short due to leaching out of beta glucans and also to ensure the correct carbohydrate level in the kettle prior to boiling, carbohydrate is still present in the

grain bed and will be lost when the spent grain is disposed of. This reduces yield and increases effluent charges.

5 In brewing applications discharging high BOD wastewater means that only limited extraction of carbohydrate from malt has occurred during processing of the wort. A higher yield from the wort's raw materials may be obtained if waste is discharged with low level BOD.

10 The wort preparation method discussed above also requires large and costly elements such as the kettle and whirlpool. Manufacturing of the elements required substantially increases the capital cost of setting up a production line, which is eventually passed on to the consumer through higher beer prices.

15 Further, the wort preparation method listed above is slow and relatively inefficient. The wort requires long cooking times, and large amounts of heat via steam percolators to be applied and subsequently removed during processing. The large quantities of steam required leads to substantial boiler house capital investment and fuel costs.

20 Filtered beers are also well known in the art. With these beers the fermented wort is filtered through a micro-filtration unit to remove any enzymes or microbiological components, sterilising the beer. A filtered beer is sterilised by the filtering stage and does not need to be pasteurized before it is bottled, thereby providing a distinctly flavoured and unique beer.

25

A method of processing a preparation that solved any or all of the above problems would be of great advantage over the prior art.

Specifically, a new processing method and apparatus which:

- a) reduce the capital cost of setting up a production line, or
- 5 b) maximised the amount of carbohydrate extracted from the malt used, or
- c) reduced the amount of high BOD waste water produced, or
- c) reduced the wort preparation time and the amount of energy required, or
- 10 e) reduced the level of wort oxidation, or
- f) prevented the formation of DMS within the wort, or
- 15 g) promoted the retention of head forming agents occurring naturally in the malted grain,

would solve a number of major problems associated with prior art methods of preparing a wort.

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It is an object of the present invention to address the foregoing problems or at least to provide the public with a useful choice.

Further aspects and advantages of the present invention will become apparent  
25 from the ensuing description that is given by way of example only.

**DISCLOSURE OF INVENTION**

According to one aspect of the present invention there is provided a method of processing a preparation for use in the production of a beverage using at least one  
5 filter stage, and at least one treatment stage,

the method characterised by the steps of:

- 10 a) transferring a preparation into a filter stage, and
- b) passing a first constituent fluid from the preparation out of the filter stage and retaining required components of the preparation in the filter stage, and
- 15 c) transferring the retained components of the preparation to a treatment stage when the retained components exhibit a desired characteristic.

According to another aspect of the present invention there is provided a filtering device for a preparation is used in the production of a beverage,  
20 the filtering device including at least one filtering stage, and is characterised in that a filtering stage is adapted to pass a first constituent fluid of the preparation, and retain required components of the preparation.

In a preferred embodiment the preparation to be processed may be wort used to  
25 prepare beer. Wort is a liquid formed from ground malted grain added to warm water. This basic mixture is normally filtered, treated then fermented to produce beer.

Alternative embodiments of the present invention may not employ wort as the preparation processed in conjunction with the present invention. For example, other preparations may be used to produce cider, wine or any other beverage, and reference to the above should in no way be seen as limiting.

5

Reference throughout this specification shall now be made to the preparation to be processed as being wort. However, it should be appreciated by those skilled in the art that any other type of preparation may be used in conjunction with the present invention and reference to the above should in no way be seen as limiting.

10

In a preferred embodiment a first constituent fluid of the wort may be water. This first constituent fluid is to be removed to further concentrate the wort. As the main component of wort is water, the removal of water will quickly concentrate the required components of the wort.

15

Alternative embodiments of the present invention may not pass water only from the wort using a filtering stage. For example, in other embodiments water as well as other waste components may be passed out of a filtering stage while retaining the required components within the filter stage.

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In a preferred embodiment a desired characteristic which determines when the retained components of the wort are transferred to a treatment stage is the concentration levels of carbohydrate within the wort. Preferably, these carbohydrate concentration levels are determined by measuring the specific gravity of the wort as water is passed from a filtering stage.

25

Alternative embodiments may not use carbohydrate concentration levels as the desired characteristic that determines when the wort is transferred to a treatment

stage. For example, in other embodiments the desired characteristic used may be the wort colour, viscosity or the concentration level of waste or other unwanted compounds within the wort.

- 5 In a preferred embodiment the required components of the wort will mostly consist of a mixture of water, carbohydrate compounds, flavour components, head retention components and colour components. Such a mixture of components is required to keep the wort in a liquid form and also to ensure that the wort contains material that may be readily fermented to produce the distinctive flavourings  
10 present in beer.

- In a preferred embodiment a filter stage may include a membrane filter. Such membrane filters can be produced with customised pore sizes to trap and retain particular types of chemicals while allowing others to permeate through the  
15 membrane.

- The use of such a filter stage allows the present invention to be used in either batch or continuous flow processing operations. For example, in one embodiment the filter stage may be configured to process wort by the wort being passed  
20 through the membrane filter a number of times until the retained components of the wort exhibit a desired characteristic. Alternatively, the filter stage may be designed so that it can be used in continuous flow processing operations, where a single pass of the wort stream through the filter stage may result in the retained components of the wort exhibiting a desired characteristic.

25

In a further preferred embodiment a filter stage includes a reverse osmosis membrane. Such reverse osmosis membranes are configured to allow water to pass or permeate through the membrane while retaining all other components to

form a retentate. This type of membrane is particularly well adapted to this application as it allows the concentration of carbohydrates within the wort to be readily increased.

5 In an alternative embodiment a filter stage may not include a reverse osmosis membrane. For example, in one alternative embodiment a nano filtration membrane may be used as a filter stage. Such nano filtration membranes operate in a similar manner to reverse osmosis membranes but also allow some forms of mono-valient salts (for example sodium ions) through a membrane in addition to  
10 water. In yet another alternative embodiment a combination of both reverse osmosis membranes and nano filtration membranes may be used as a filter stage. The use of a nano filtration membrane in this application has the potential to give a characteristic and possibly improved new flavour to the resulting beer produced from the wort processed.

15

In yet a further preferred embodiment a filter stage may include a spiral wound reverse osmosis membrane. This configuration of reverse osmosis membrane may be easily adapted to this particular type of application.

20 Alternative embodiments of the present invention may not employ reverse osmosis membrane filters in a filter stage or a spiral wound reverse osmosis membrane. For example, alternative embodiments may employ any type and shape of filtering membrane or apparatus that readily passes water through the filter stage while retaining components of the wort within the filter stage. Those  
25 skilled in the art should appreciate that any types of apparatus which functions in the same way as a reverse osmosis membrane, (or which alternatively may be a flat sheet membrane) may be used in the filter stage. Reference to the above only throughout this specification should be in no way seen as limiting.

Reference throughout this specification shall now be made to a filtering stage as including a reverse osmosis membrane. However, it should be appreciated by those skilled in the art that other types of filter stage may be used in conjunction with the present invention and reference to the above should in no way be seen as limiting.

In a preferred embodiment the transfer of wort into a filter stage may consist of placing the fluid in contact with the filter stage reverse osmosis membrane. This transfer allows water from the wort to permeate through the filter stage, thereby concentrating the retained wort.

In a preferred embodiment water that has permeated through the reverse osmosis membrane may be recirculated back into a lauter tun used at the start of the preparation process. In this way the permeated water may be recirculated back to the original source of the wort. Recycling wastewater in this way reduces water consumption and wastewater production.

In a preferred embodiment a treatment stage may consist of a number of elements, which heat treat, cool and oxygenate the wort and lastly transfer it to a fermenter. These treatment stages complete the final processing of the wort, making it ready to be fermented into beer.

Alternative embodiments of the present invention may not employ a treatment stage as listed above. For example in alternative embodiments any or all of the treatments stage elements listed above may be employed as required.

According to a further aspect of the present invention there is provided a method of processing a wort stream used in the production of a beer, using at least one reverse osmosis membrane as a filter stage and at least one treatment stage,

5 the method characterised by the steps of:

- a) transferring the wort stream into contact with a reverse osmosis and/or nano filtration membrane, and
- b) passing water from the wort out through the membrane as a permeate and  
10 retaining required components of the wort in contact with membrane as a retentate, and
- c) transferring the retained components of the wort stream to a treatment stage  
15 once carbohydrates in the wort have reached a set predetermined concentration.

As can be readily appreciated the above invention allows wort for the production of beer to be quickly and cheaply processed. Capital costs for setting up a production line are reduced as the need for a kettle to set the carbohydrate  
20 concentrate level within the wort is eliminated.

According to yet another aspect of the present invention there is provided a method of processing a preparation for use in the production of a beverage using at least one screening stage,

25

characterised by the steps of:

- a) transferring a preparation into a screening stage, and

- b) passing required components of the preparation through the screening stage while retaining waste beta-glucans, or polyphenols or enzymes or microbiological compounds, or protein products containing compounds within the filter stage.

According to another aspect of the present invention there is provided a screening device for a preparation used in the production of a beverage, the screening device including a screening stage adapted to pass required components of the preparation while retaining waste beta-glucans or polyphenols or enzymes or microbiological compounds or protein containing compounds within the screening stage.

In a preferred embodiment the required components passed through a screening stage may consist of water mixed with carbohydrate compounds. A filtering stage is required to remove waste compounds such as proteins, polyphenols, beta-glucans, enzymes or microbiological components that degrade the taste of a beer and make the beer appear cloudy.

Reference throughout this specification shall now be made to a screening stage as being configured to retain beta-glucans, enzymes, microbiological components, polyphenols and protein containing compounds within the screening stage. However, it should be appreciated by those skilled in the art that such a screening stage may be configured to retain any number and type of waste products within the screening stage, and reference to the above types of chemicals should in no way be seen as limiting.

In a preferred embodiment a screening stage may include a filter membrane. Filter membranes can be produced to trap and retain particular types of compound with customised pore sizes, while allowing other types of chemicals to permeate through the membrane.

5

In a further preferred embodiment a screening stage includes an ultra filtration membrane with pore sizes ranging from 0.001 to 0.1 micrometers. This may be contrasted with standard micro filtration membranes currently used in the production of beer, which have pore sizes ranging from 0.1 to 1.5 micrometers.

10 Ultra filtration membranes may be used in the present invention to catch selected particles such as beta-glucans, enzymes and microbiological components, polyphenols or protein containing compounds while still allowing the remainder of the wort to permeate through the membrane.

15 In an alternative embodiment an ultra filtration membrane may not necessarily be used as a screening stage. For example, in one alternative embodiment a micro filtration membrane with a pore size of between 0.1 to 2.0 micrometers may also be used within the screening stage. Those skilled in the art should appreciate any type of filtration membrane may be used as a screening stage in the present  
20 invention and reference to the use of ultra filtration membranes only throughout this specification should in no way be seen as limiting.

In yet a further preferred embodiment a screening stage may include a tubular ultra filtration membrane. A tubular membrane is preferred in this embodiment  
25 due to the large amount of particular matter in the wort stream at this stage of the process. The wort will contain a high level of particulates even though it may appear clear. A tubular UF will not physically be blocked by these particulates.

Reference throughout this specification shall now be made to a screening stage as employing an ultra filtration membrane as discussed above. However, it should be appreciated by those skilled in the art that any type of filtration membrane may be used in conjunction with the present invention and reference to pore sizes from  
5 0.001 to 0.1 micrometers should in no way be seen as limiting.

Use of an ultra filtration membrane also allows the wort stream to be dia-filtrated. Dia-filtration techniques involve the use of carrier fluids such as water to wash or push required components of a compound through filter stages relatively quickly.  
10 With regard to the present invention, large amounts of water are already mixed with the wort's carbohydrates components. This water washes these components through the ultra filtration membrane relatively quickly.

In some embodiments additional water may also be added to aid dia-filtration of  
15 the wort. In such an embodiment it may be possible to wash high levels of carbohydrate from the wort stream in one pass through the screening stage.

In a preferred embodiment wort is transferred into a screening stage from a lauter tun. This configuration of the invention allows the waste products listed above to  
20 be removed from the wort before it is heat treated or concentrated.

The method of processing a preparation using a screening stage as discussed above provides many advantages over the prior art.

25 The use of a screening stage eliminates the need to boil wort in the kettle to precipitate solid protein from the solution. Using the present invention proteins may be filtered from the wort stream without requiring additional cooking time

and heat treatments. Further, the requirement for a whirlpool is also eliminated as proteins can be removed from the wort by a screening stage.

5 The invention discussed above which employs a screening stage also allows extended sparging of wort in the lauter tun. As the screening stage will remove any beta-glucans formed within the lauter tun, the wort can be extensively diluted without fear of degrading the quality of the beer to be produced. This results in more efficient use of malt, allowing most of the carbohydrate present to be extracted.

10

In a preferred embodiment compounds retained within a screening stage may be recirculated back to the start of the screening stage or lauter tun and diluted with the remaining volume of the preparation still to be screened. This allows waste components to be repeatedly screened to ensure that all required components are  
15 passed from the preparation.

In an alternative embodiment waste components may be transferred from a screening stage and into a further storage or additional treatment stage. In such embodiments it is believed that the waste components may be highly concentrated  
20 and either require careful disposal or further treatments before they are disposed of.

In a preferred embodiment, required components may be transferred straight on into further stages of processing the preparation. This immediate transfer  
25 decreases processing times for the preparation and eliminates requirements for storage tanks in the processing apparatus. However alternative embodiments may still employ storage tanks to store the screened preparation until it may be further processed by other preparation stages.

The applicants believe that the use of such a screening stage also has the potential to removing yeast-inhibiting compounds that slow the fermentation of wort into beer. The use of such a screening stage in the present invention may substantially reduce the time period required for wort to ferment into beer.

5

According to a further aspect of the present invention there is provided a method of processing a wort for use in the production of beer using a screening stage, a filter stage and a treatment stage

10 the method characterised by the steps of:

- a) transferring wort into a screening stage, and
- b) passing the water and carbohydrate components of the wort through the  
15 screening stage while retaining waste beta glucans, polyphenols, protein products, enzymes or microbiological components within the screening stage, and
- c) transferring water and carbohydrate components of the wort into a filter  
20 stage, and
- d) passing some water from the wort out of the filter stage and retaining the remaining carbohydrate containing wort in the filter stage, and
- e) transferring the wort to a treatment stage when the wort exhibits a desired  
25 specific gravity or volume.

According to yet another aspect of the present invention there is provided a processing device for a preparation used in the production of a beverage, said processing device including a filtering device and a screening device substantially as described above.

5

In a preferred embodiment both the screening stages and filtering stages discussed in the above method may be combined together into a single method of processing a wort stream. This combination allows the screening stage to firstly remove waste components from the wort such as beta-glucans, enzymes and microbiological components, polyphenols and protein, and then pass the required components of the wort into a filtering stage. The filtering stage may next concentrate the wort by removing excess water from the solution and then pass the concentrated required components into the next treatment stage. From the treatment stage the concentrated wort can then be prepared for brewing and transferred to a fermenter.

15

The combined elements discussed above may work together to eliminate the requirement for both a kettle and whirlpool stage as used in existing preparation methods. Protein and other waste products are initially removed via an ultra filtration membrane after the lauter tun. Secondly, water may be removed from the wort with the filtering stage reverse osmosis membrane which retains the required components of the wort as a retentate and recycles the permeate water back into the lauter tun.

20

The combination of elements discussed above allows an efficient and cheap wort processing plant to be constructed. Further, use of the ultra filtration membrane increases the yield obtained from the wort's starting materials as a maximum amount of carbohydrate can be extracted from the malt used. The waste products

25

from each stage can also be recycled back into the lauter tun for multiple passes through the system to extract as much carbohydrate as possible while reducing the volumes of wastewater produced.

- 5 The volumes of water used in such a system are also limited. Clean sterile water can be obtained as a permeate from the reverse osmosis membrane then plumbed back into the lauter tun creating a closed system into which very little extra water needs to be added during processing of wort. The same treatment may also be applied to the retentates from the ultra filtration membrane that can be plumbed  
10 back into the lauter tun.

Additional additives such as sugar or liquid hops may be added to the wort stream after the reverse osmosis membrane. Such additives may be provided at this stage to modify the resulting beer's flavour and colour as required.

15

The present invention as described above provides many advantages over existing methods of wort production.

- The present invention uses the filters discussed above in a completely new  
20 application for beer production. Previously no use has been made of ultra filtration membranes to remove and separate out protein from wort that substantially increases and simplifies the extraction of carbohydrates from wort within a lauter tun. This allows carbohydrate extraction at the lauter tun stage to be done quickly and cheaply when compared with existing wort processing  
25 methods.

An ultra filtration membrane may be easily configured to extract carbohydrate from wort transferred from a lauter tun, leaving waste protein residue within the

lauter tun, and replacing the need for a kettle and whirlpool. A reverse osmosis membrane can be used to control the volume and/or the specific gravity of the wort stream, and in combination with the ultra filtration membrane discussed above eliminates the need for a kettle and whirlpool in the wort preparation  
5 apparatus.

The present invention may allow a totally new and uniquely flavoured beer to be produced. By removing the requirements for a kettle and whirlpool the wort experiences extremely limited oxidation during processing. This preserves all the  
10 resulting beers organoleptic components, and also preserves head-retaining components within the beer – reducing or eliminating the need to add additional artificial additives.

The present invention eliminates the requirement for both a kettle and a whirlpool  
15 stage. Water and other waste products may be easily and cheaply removed from a wort stream without large, costly and bulky apparatus.

The present invention substantially reduces the BOD of wastewater produced during wort preparation and increases the carbohydrate yield from the raw  
20 materials used. Water permeated through the reverse osmosis membrane may be added back into the lauter tun, reducing the amount of wastewater discharged during the preparation process. The present invention also allows greater levels of carbohydrate to be extracted from the malt in the lauter tun. A brewer may sparge the wort in the lauter tun extensively, with reduced risk of beta-glucans being  
25 carried through to the final beer produced.

The present invention reduces the wort preparation time substantially and also reduces the amount of energy required during the preparation process to heat and

subsequently cool the wort. Dia-filtration techniques can also be used in processing the wort, as the reverse osmosis membrane used can easily remove large quantities of water from the wort stream.

- 5 The present invention lends itself well to batch brewing processes so a large batch of wort may be prepared quickly and subsequently transferred to a fermenter. The present invention may also be considered for continuous brewing processing as the membrane plants will be capable of processing wort from one or more brews.

10 **BRIEF DESCRIPTION OF DRAWINGS**

Further aspects of the present invention will become apparent from the following description that is given by way of example only and with reference to the accompanying drawings in which:

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Figure 1 illustrates a block diagram of prior art methods of processing wort, and

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Figure 2 illustrates a block diagram of the processing method associated with the present invention in one embodiment, and

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Figure 3 Tables A and B provide a contrast between the steps taken and time required for a prior method and the method of the present invention as in another embodiment.

**BEST MODES FOR CARRYING OUT THE INVENTION**

Figure 1 illustrates a block diagram of a prior art method of processing wort.

5 This known method employs processing apparatus 1 that consists of a number of components. These components are a mash tun 2, a lauter tun 3, a sparge water supply 3a, a recirculation path 4, a kettle 5, whirlpool 6, heat exchanger and oxygenator 7 and fermenter 8.

10 In use, malted grain is mixed with hot water in the mash tun 2, agitated and then transferred to the lauter tun 3. Hot sparge water at 75°C is then added from the sparge water supply 3a. This mixture is then circulated through perforated holes in the bottom of the lauter tun 3 and transferred through the recirculation path 4. Circulation through the bottom of the lauter tun 3 acts as a filtering process to remove carbohydrates from solid material that has fallen to the bottom of the  
15 lauter tun 3.

Next the wort is transferred from the lauter tun 3 to the kettle 5. Within the kettle the wort is boiled to achieve the correct gravity (carbohydrate level) to sterilise the wort and to also precipitate out solid proteins.

20

After the correct concentration of carbohydrates within the wort is obtained, the wort is transferred to the whirlpool 6 on a tangential angle. This tangential introduction spins the wort within the whirlpool, forcing precipitated protein into the centre of the whirlpool where it is retained within a central retaining ring (not  
25 shown).

Next the water is drained from the whirlpool 6, and transferred to the heat exchanging and oxygenating section 7 where the wort temperature is cooled to 12°C and sterilised air or oxygen is bubbled through the solution.

- 5 Finally the wort is pitched with yeast and transferred to a fermenter where it is left to ferment into beer.

Figure 2 shows a block diagram of the processing method associated with the present invention.

10

Figure 2 shows in block form a number of components incorporated into a wort processing apparatus 11. The wort processing apparatus 11 includes a mash tun 12, a lauter tun 13, a first recirculation path 14 which includes a heat exchanger 20, a screening stage, shown in this embodiment as an ultra filtration membrane 15  
15 with a second recirculation path 19, a filtering stage, shown in this embodiment as a reverse osmosis membrane 16, a heat exchanging and oxygenating section 17 and a fermenter 18.

In use, malted barley and hot water are added together and agitated in the mash  
20 tun 12 to form the basic components of wort. Next the wort is transferred to a lauter tun 13 and processed in substantially the same manner as that discussed with respect to figure 1.

Next the wort is transferred through the ultra filtration membrane 15. This  
25 membrane traps waste products in the wort such as, for example, polyphenols, proteins and beta-glucans while allowing the required components of the wort to pass on to the reverse osmosis membrane 16. As some carbohydrates are retained

on the waste product side, this stream is recirculated back to the lauter tun via the membrane second recirculation path 19.

5 The reverse osmosis membrane 16 allows water to pass through the membrane on to the first recirculation path 14, through which the water is added back into the lauter tun 13.

This recirculated water is also heated to approximately 75°C by the heat exchanger 20 before it is added back into the lauter tun 3.

10

Once the correct amount of water has been removed from the wort by the reverse osmosis membrane 16, the wort is transferred to the heat exchanging and oxygenating stage 17. This stage cools the wort to approximately 12°, bubbles sterile air or oxygen through the fluid, pitches the wort with yeast and then  
15 transfers it to the fermenter 18. Once in the fermenter 18 the wort is left to ferment into beer.

Tables A and B provide a contrast between the steps taken and time required for a prior art wort preparation method and the method of the present invention.

20

As can be seen from the tables, the present invention requires approximately half the time to prepare the same amount of wort than that used in the prior method.

Aspects of the present invention have been described by way of example only and it should be appreciated that modifications and additions may be made thereto  
25 without departing from the scope thereof as defined in the appended claims.

WHAT I/WE CLAIM IS:

- 1 A method of processing a preparation for use in the production of a beverage using at least one filter stage, and at least one treatment stage, the method characterised by the steps of:
  - (a) transferring a preparation into a filter stage, and
  - (b) passing a first constituent fluid from the preparation out of the filter stage, and retaining required components of the preparation in the filter stage, and
  - (c) transferring the retained components of the preparation to a treatment stage when the retained components exhibit a desired characteristic.
- 2 A method as claimed in claim 1 wherein the preparation to be processed is wort used to prepare beer.
- 3 A method as claimed in claim 1 or claim 2 wherein the first constituent fluid of the preparation is water.
- 4 A method as claimed in any previous claim, wherein the desired characteristic that determines when the retained components of the preparation are transferred to a treatment stage is the concentration level of carbohydrate within the preparation.
- 5 A method as claimed in any previous claim, wherein the filter stage includes reverse osmosis membrane.
- 6 A method as claimed in any previous claim, wherein the filter stage includes a nano filtration membrane.
- 7 A method as claimed in any one of claims 3 to 6, wherein water that is passed through the filter stage is recirculated back to the original source of the preparation.

- 8 A method of processing a wort stream used in the production of a beer, using at least one reverse osmosis and/or nano filtration membrane as a filter stage and at least one treatment stage, the method characterised by the steps of:
- (a) transferring the wort stream into contact with a reverse osmosis and/or nano filtration membrane, and
  - (b) passing water from the wort out through the membrane as a permeate and retaining required components of the wort in contact with the membrane as a retentate, and
  - (c) transferring the retained components of the wort stream to a treatment stage once carbohydrates in the wort have reached a predetermined concentration.
- 9 A method of processing a preparation for use in the production of a beverage using at least one screening stage, characterised by the steps of:
- (a) transferring a preparation into a screening stage, and
  - (b) passing required components of the preparation through the screening stage while retaining waste beta-glucans, or polyphenols or enzymes or microbiological compounds, or protein containing compounds within the filter stage.
- 10 A method as claimed in claim 9, wherein the required components that pass through a screen stage include water mixed with carbohydrate compounds.
- 11 A method as claimed in claims 9 or 10, wherein the filter stage includes an ultra filtration membrane
- 12 A method as claimed in any one of claims 9 - 11, wherein the screening stage includes a micro filtration membrane.
- 13 A method as claimed in any one of claims 9 - 12 wherein the preparation is transferred to a screening stage from a lauter tun.

- 14 A method as claimed in claim 13, wherein compounds retained within a screening stage may be recirculated back to the lauter tun.
- 15 A method of processing wort for use in the production of beer using a screening stage, a filter stage and a treatment stage, the method characterised by the steps of:
- (a) transferring wort into a screening stage, and
  - (b) passing the water and carbohydrate components of the wort through the screening stage while retaining waste beta glucans, polyphenols, protein containing compounds, enzymes or microbiological components within the screening stage, and
  - (c) transferring water and carbohydrate components of the wort into a filter stage, and
  - (d) passing at least some water from the wort out of the filter stage and retaining the remaining carbohydrate containing wort in the filter stage, and
  - (e) transferring the wort to a treatment stage when the wort exhibits a desired specific gravity, or carbohydrate concentration or volume.
- 16 A filtering device for a preparation used in the production of a beverage, the filtering device including at least one filtering stage, wherein a filtering stage is adapted to pass a first constituent fluid of the preparation, and retain required components of the preparation.
- 17 A screening device for a preparation used in the production of a beverage, the screening device including a screening stage adapted to pass required components of the preparation while retaining waste beta-glucans or polyphenols or enzymes or microbiological compounds, or protein containing compounds within the screening stage.
- 18 A processing device for a preparation used in the production of a beverage, the processing device including a filtering device as claimed in claim 16, and a screening device as claimed in claim 17.

- 19 A method of processing wort substantially as herein described with reference to and as illustrated by the accompanying figure 2 and/or the examples given.
- 20 An apparatus for processing wort substantially as herein described with reference to and as illustrated by the accompanying figure 2 and/or examples given..

Fig. 1

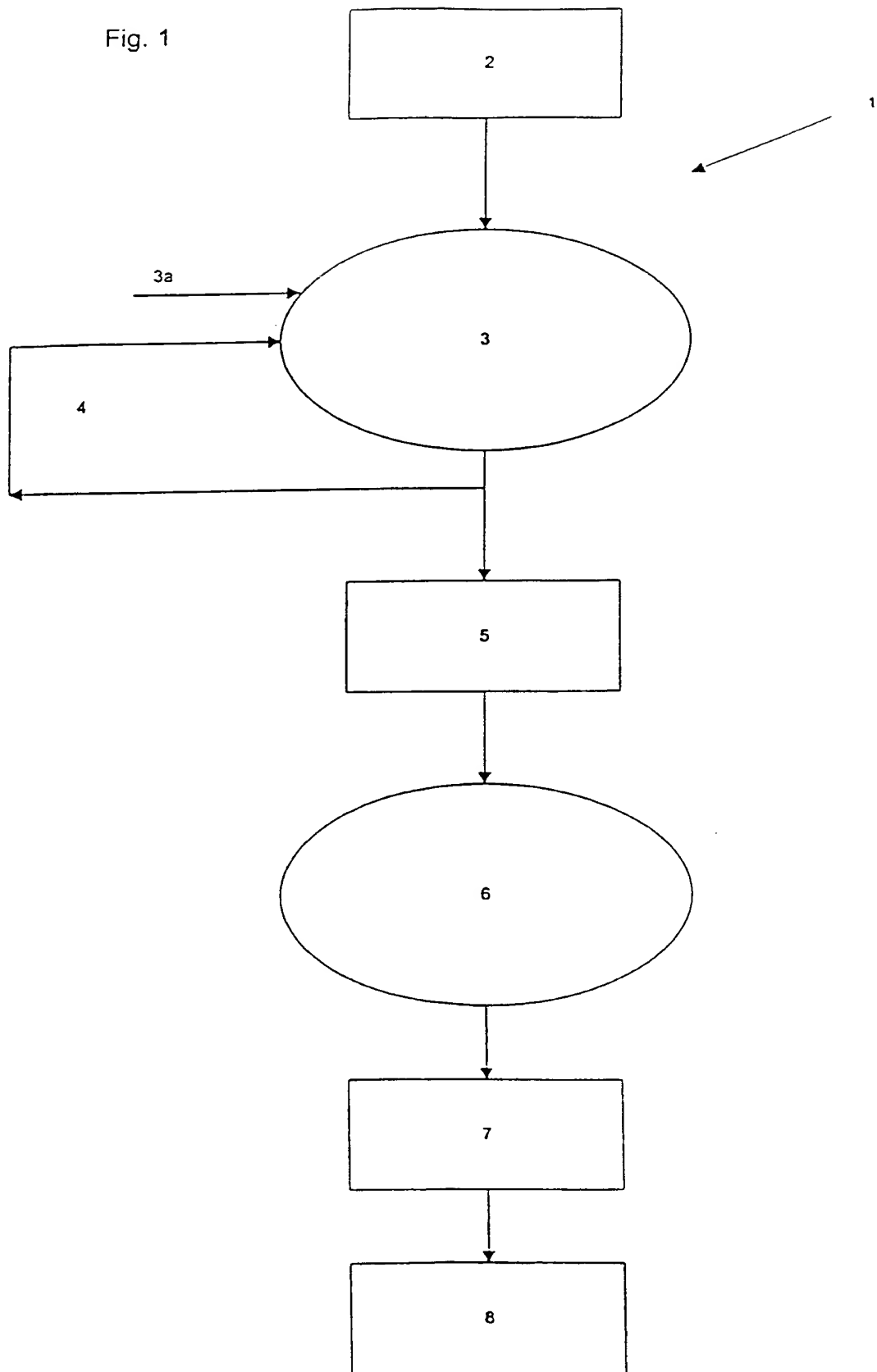


Fig. 2

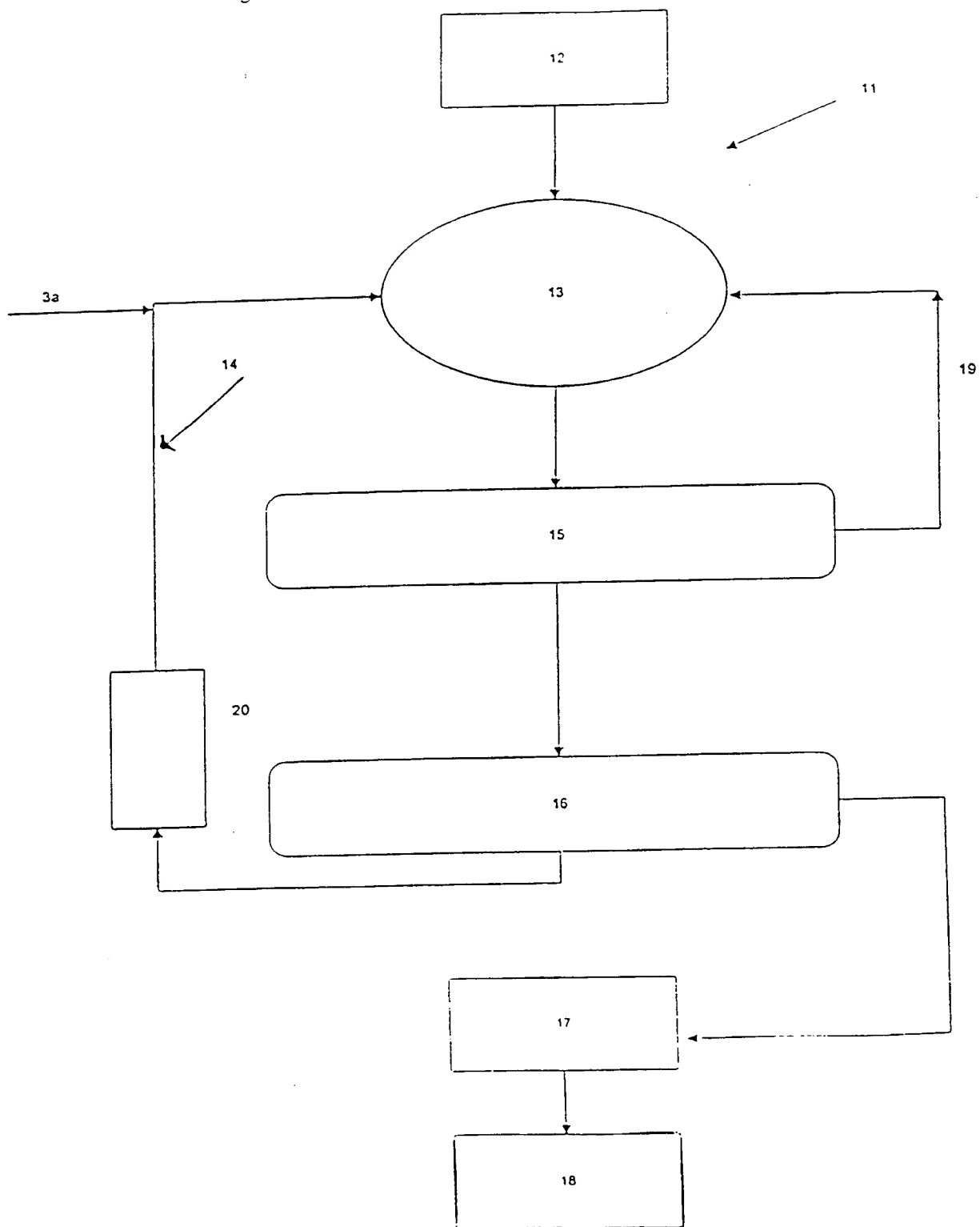


TABLE A

<u>ACTION</u>	<u>TIME REQUIRED (MINUTES)</u>
Wort formation in malt tun.	40
Transfer and circulate in lauter tun.	150
Boil in kettle.	60
Transfer and stand in whirlpool.	20
Cool, oxygenate and transfer to fermenter.	90
<u>TOTAL TIME</u>	<u>360</u>

TABLE B

<u>ACTION</u>	<u>TIME REQUIRED (MINUTES)</u>
Wort formation in malt tun.	40
Transfer mash to lauter tun.	10
Circulate wort in lauter tun, screen through UF membrane. Transfer through RO membrane. Cool oxygenate and transfer to fermenter.	140
<u>TOTAL TIME</u>	<u>190</u>

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## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification <sup>6</sup> :</b>  <b>C12C 7/14, 7/28</b>	<b>A3</b>	<b>(11) International Publication Number:</b> <b>WO 99/47636</b>  <b>(43) International Publication Date:</b> 23 September 1999 (23.09.99)
<b>(21) International Application Number:</b> PCT/NZ99/00031 <b>(22) International Filing Date:</b> 16 March 1999 (16.03.99)  <b>(30) Priority Data:</b> 329960 16 March 1998 (16.03.98) NZ  <b>(71) Applicant (for all designated States except US):</b> ENVIRONMENT PRODUCTS LIMITED [NZ/NZ]; 667 Great South Road, Penrose, Auckland 1006 (NZ).  <b>(72) Inventor; and</b> <b>(75) Inventor/Applicant (for US only):</b> MOFFAT, David, John [AU/AU]; 8 Mascoma Street, Ascot Vale, VIC 3032 (AU).  <b>(74) Agents:</b> SIMS, Anthony, W. et al.; 29 Clarence Street, P.O. Box 759, Hamilton 2001 (NZ).		<b>(81) Designated States:</b> AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).  <b>Published</b> <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>  <b>(88) Date of publication of the international search report:</b> 25 November 1999 (25.11.99)
<b>(54) Title:</b> IMPROVED METHOD AND APPARATUS FOR PROCESSING A PREPARATION		
<b>(57) Abstract</b>  The present invention relates to a method of processing a wort stream used in the production of a beer, using at least one reverse osmosis membrane or nano filtration membrane as a filter stage, and at least one treatment stage wherein the method is characterised by the steps of: a) transferring the wort stream into contact with the filter stage, and b) passing water from the wort out of the filter stage as a permeate and retaining required components of the wort in contact with the filter stage as a retentate, and c) transferring the retained components of the wort stream to a treatment stage once carbohydrates in the wort have reached a set concentration level. A method for screening the wort to remove waste products using a screening stage before the wort reaches the filtering stage is also disclosed. The present invention provides a method and apparatus for removing the traditional requirement of the kettle and a whirlpool in the production of wort to be fermented into beer.		

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# INTERNATIONAL SEARCH REPORT

International Application No

PCT/NZ 99/00031

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 6 C12C7/14 C12C7/28

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**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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A,P		14,16
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